SEVEN WONDERS OF MEDICAL SCIENCE—MODERN MIRACLES*

By A. C. Ivy, Ph.D., M.D.
Chicago, Illinois

JUST as nature forces animals and plants to adapt themselves to their environment in order to survive, nature impels man to invent and discover the ways and means for exercising a greater control over his environment in order that his life may be easier and more complete.

The ant and the bee labor and save and have a highly organized society, but they do not progress appreciably. It is man's ability to improve his workmanship, his ability to discover and invent, that makes it possible for him to progress. In order to invent and discover, man must use either the uncertain empirical method which is based chiefly on guessing and faith, or the more certain scientific or experimental method which is based on the discovery of the laws of nature, their analysis and practical application.

It is through the use of the scientific method of controlled experimentation, which yields a knowledge of the fundamental principles of nature, that man during the past two centuries has achieved such a remarkable understanding and relative control over his environment. It is through animal experimentation to a large extent that man has achieved his present success in the battle against disease—a battle which, of course, is still under way. Only through a perusal of history may one gain an appreciation of *the horrors of disease* from which present-day civilization has been more or less freed through the application of the discoveries of medical science.

SEVEN WONDERS OF MEDICAL SCIENCE

Seven wonders of medical science may be described briefly as follows:

1. *Anesthesia and analgesia,* which gives us relief from pain and have liberated us from the pain of operations without anesthetics.

2. *The germ causation of infectious diseases,* which has made possible the obliteration of the horrors due to cholera, plague, yellow fever, childbirth fever, typhoid, etc., from intelligent and well-governed communities.

3. Our present knowledge of *immunity and body resistance to disease,* which would eradicate smallpox and diphtheria from the face of the earth if put into universal practice. This also includes our knowledge of specific "antisera" against lockjaw, diphtheria, scarlet fever, rabies, specific meningitis, etc.

4. *Antisepsis and asepsis,* a knowledge of which makes possible the prevention of wound infection and blood poisoning, and operations on all diseased organs.

5. *Knowledge of symptoms, which is based on a knowledge of physiology.* Symptoms result when the physiology of an organ is disturbed, and only when the functions of organs are known can disease of an organ be accurately determined. The use of x-rays helps tremendously.

6. *Organotherapy, which is based on a knowledge of physiology.* For examples, we may cite the use of *insulin* in diabetes, *thyroid extract* in certain children showing undergrowth and poor mental development, *liver extract* in *pernicious anemia,* etc.

7. *Animal nutrition and vitamins,* as related to growth and the prevention of such diseases as rickets, scurvy, polyneuritis, pellagra, etc.

Our knowledge of nutrition and the vitamins has also rendered it possible to increase our food supply, to prevent certain chronic diseases and malnutrition in children, and in times of war and economic depression to balance diets so that "war edema" and other evidences of malnutrition may be prevented.

We should add to this list the growing appreciation among the medical profession and laity of the necessity and importance of periodic health examination to discover in the individual the early signs of impending chronic diseases—for example, the discovery of *cancer* in its early stages when a *cure is possible.*

It should be realized that cancer is one of the most fundamental and difficult problems that confront biologic science. It involves the question of growth, because all cancerous tissue possesses the common habit of disorderly growth. Such fundamental questions cannot be answered in a brief period of time, and can only be answered by long-continued and intensive study. But the fight is on and much progress has been made. Cancers have been transplanted from one animal to another of the same family. They have been produced experimentally through chronic irritation. Some cancers have a distinct hereditary tendency. It is by such knowledge, gained through animal experimentation, that the war on cancer, which kills more than one hundred thousand persons yearly in the United States, will be won.

DISCOVERIES RESULTING SOLELY OR CHIEFLY FROM EXPERIMENTS ON DOGS

1. *Insulin,* which controls *diabetes* in man and dog. There are one million people living in the United States today who now have or later will develop diabetes, and who will have their *lives prolonged and enriched* by the use of insulin. This discovery was made solely on dogs.

2. *Liver extract for pernicious anemia.* Liver extract causes the blood to *return to normal* in patients afflicted with this disease. Liver was found to be a good food for anemic dogs. This was applied to patients with miraculous results.

3. *Treatment of parathyroid tetany.* Prior to 1925 practically all patients afflicted with this dreadful disease died. *Today no patient need die of this disease.*

4. *Ethylene anesthesia.* The discovery of many and our knowledge of the action of all anesthetics and sleep-producing drugs have come chiefly from experiments on dogs.

* EDITOR'S NOTE: This is an abstract of an unprinted lecture by Dr. A. C. Ivy, professor of physiology and pharmacology, Northwestern University, Chicago, Illinois. CALIFORNIA AND WESTERN MEDICINE is indebted to Professor Ivy for his permission to print this excellent defense of animal experimentation. [Footnote printed in 1934.]

5. *Ether,* which has been called the "greatest gift of medicine to mankind," was first tried out by Dr. W. T. G. Morton in a series of experiments on his own dog. His success in the dog led to a trial in man.

6. *Rabies treatment.* The use of the Pasteur treatment for rabies (mad-dog bite) has reduced the mortality from 16 per cent to less than 1 per cent. There is a *preventive treatment for dogs* which protects them to a great extent against this disease.

7. *Hookworm cure.* The hookworm infests both man and dog. *One hundred million persons* in our own and in tropical countries are infested with this parasite. Most all we know about this parasite resulted from studies on the dog. Carbon tetrachlorid was found to rid the body of hookworm. Then, tetrachlorethylene was found to be as effective but less toxic to the patients. More than fifteen million treatments have been given to dogs and human beings.

8. *Treatment of Addison's disease.* Addison's disease is caused by disease of the adrenal glands. *These patients die slowly.* Recently it has been discovered by experiments on dogs and cats that *this disease can be controlled* by the administration of appropriate *extracts of the adrenal glands.*

9. *Contributions to chemical warfare service:*

(*a*) A satisfactory treatment for phosphorus burns.

(*b*) A satisfactory treatment for burns and other effects caused by poisonous gases.

(*c*) An improved method for treatment for lung irritants like phosgene.

(*d*) Effects of gas (automobile exhaust, cooking gas) poisoning and process of recovery.

(*e*) Facts bearing on shell shock.

(*f*) Facts bearing on treatment of traumatic shock, or shock following severe injury.

10. *Methods of resuscitation:* In drowning, coal-gas poisoning, and electrocution, cyanide poisoning.

11. Almost all we know about the *stomach, intestine,* and *liver.*

12. Much that we know about *heart action* and the effects of drugs on it.

13. Much that we know about *dropsy,* and *kidney disease.*

14. The accuracy of the indirect method of measuring *blood pressure* in man. When the physician takes the blood pressure, he and his patient should remember the *debt owed to the dog.*

15. Development of new operations:

(*a*) On the heart and its valves.

(*b*) On the lungs.

(*c*) On the blood vessels.

(*d*) On the brain.

(*e*) On the stomach and intestines.

(*f*) On the blood transfusion.

(*g*) On the ovaries and womb.

16. *Rickets,* a common disease that affects children and young animals. The first experiments bearing on the cause and cure of this disease were performed on puppies. Now *this disease can be prevented and cured.*

17. *Antidotes* to veronal and luminal (sleeping drugs) poisoning.

18. *On the action of some powerful drugs.* The action of a number of medicines: *epinephrin,* which is used to check hemorrhage and to abolish distress in asthma, is tested on dogs by United States Government requirement. *Pituitrin,* a drug used in childbirth, is tested on guinea-pigs and dogs. *Wood alcohol* was first shown to be harmful by experiments on dogs, and the cause of "ginger jake paralysis" was found by studies on the dog.

TO SUMMARIZE

The dog's contribution to our knowledge of the function of the organs of the body would fill a volume. Scientists, who know their business and duty to society, just as the lawyer, banker, engineer, and architect know their business and duty, hold that the dog is necessary for experimental purposes. Detailed reasons cannot be pointed out to lay persons, because they do not know enough anatomy and physiology. But the following general statements can be made: *Dogs are necessary* because—

1. They can live a healthy life in relative confinement.
2. They are large and their structures can be easily operated.
3. Like man, they eat all kinds of foods.
4. They have diseases in common with man.
5. Structurally and functionally they are very similar to man.
6. They are so numerous that in large cities thousands are picked up and killed yearly. Of these, a small number are drafted for humane experiments, the results of which serve dog and man alike.

When a dog is operated on, it is put to sleep or a powerful pain-killing drug is used.

WHAT SCIENCE HAS DONE FOR THE DOG

1. We can now prevent and cure rabies in the dog.
2. We can now kill the hookworm, which infests dogs as well as man and which makes it difficult for dog fanciers to raise dogs.
3. We can now prevent and cure blacktongue in the dog.
4. We can do much to prevent and control distemper. The treatment is not perfect and further experiments must be done on the dog for the good of the dog.
5. We are now working to find a medicine that will kill the cruel heartworm in the dog.
6. We know how to operate on the dog and cure certain diseases of the thyroid gland and intestines.
7. We are learning about "puppy birth" in the dog which is important to dog fanciers.
8. We can prevent diseases in the dog due to improper food. Dogs need vitamins just as other animals do.

WHAT HAVE THE OPPONENTS OF ANIMAL EXPERIMENTATION DONE FOR EITHER MAN OR DOG?

Nothing! The opponents of animal experimentation, known also as antivivisectionists, would prevent experiments on dogs for the sake of dog-

kind. Antivivisection would make it impossible for veterinary science to experiment on one dog for the sake of dogs as a group.

Also, the opponents of animal experimentation themselves profit daily from the benefits of animal experimentation. They do not sense the fact that city life could not exist as we now know it if animal experimentation had not been practiced in the past. Without the knowledge which has come from animal experimentation, the grim specters of plague, typhus, yellow fever, malaria, and typhoid would still be rampant among us. Diphtheria would still take its toll of children's lives. Surgery would be primitive and anesthesia inadequate and unduly dangerous. Our knowledge of the function of the organs of the body and of life processes upon which the progress of medicine and the diagnosis of disease depends, would not have been gained, unless cats, dogs, guinea-pigs and other laboratory animals had been used. Scientific knowledge and the discoveries of medical science do not fall from the heavens like the manna upon which the children of Israel fed, but must be obtained through the arduous and persevering use of the scientific or experimental method. This method is the only known and proven method by which the warfare on disease may be conducted adequately and effectively. The opponents of biologic and medical progress would abolish this method, the use of which has been and still promises to be of such tremendous value to mankind.

It should not be forgotten that when crops are threatened with parasites, when farm animals and the human family are threatened by an epidemic disease, the legislators and citizens turn to the biologist and medical scientist for aid, and that the work of public health agencies are carried on either by, or under the direction of men and women trained in the medical sciences. The public has and must continue to manifest confidence in the moral and intellectual integrity, the sincerity of purpose and the humaneness of its biologists and medical scientists. The public must support them in their work, if in the future the public shall expect to benefit to a maximum extent, as it has in the past by expert advice, because expert advice is based on scientific facts which come from experimentation.

TRUSTS OPPOSING ANIMAL EXPERIMENTATION NOT CHARITABLE

"Animal experimentation as a means of promoting human and animal welfare has recently received the sanction of two tribunals of great importance, one in the United States and the other in England."

In the American case, the United States Board of Tax Appeals (25 B. T. A., Penn. Co. Insurance on Lives and Annuities, Executive Estate of A. S. Logan, deceased, petitioner v. Comm. Int. Rev., respondent) held that a bequest to a society organized for "the total abolition of all vivisectional experiments on animals and other experiments of a painful nature" was not a bequest to a corporation organized and operated exclusively for the prevention of cruelty to animals, and that the amount of such a bequest could not be deducted in computing the federal estate tax.

In the English case the Court of Appeal (The Law Journal, 71:329, 1931) raised the question whether "in the light of later knowledge in regard to the benefits accruing to mankind from vivisection," bequests designed to hinder and prevent vivisection would today be regarded as charitable bequests. On appeal, the House of Lords forbade the use for antivivisection propaganda of any part of the legacy concerning which the question was raised.

"Probably these two decisions represent the general trend of mature and cultured thought on the subject of animal experimentation, when uninfluenced by lurid appeals to the imagination. Both decisions were based on the orderly presentation of legal evidence, not on such clamorous, virulent, emotional speech-making as commonly fills the air when animal experimentation is discussed" by antivivisectionists before legislative committees.

Northwestern University,
303 East Chicago Avenue.

SOME OPINIONS ON ANIMAL EXPERIMENTATION

JANE ADDAMS, Hull House, Chicago: Dr. A. J. Carlson, a distinguished professor of the University of Chicago, during the World War made a most valuable study of the piteous children who were suffering from starvation, and for months worked on their behalf in southeastern Europe. Immediately after the war I accompanied a scientific friend, whose discoveries in industrial diseases have necessitated research with living animals, in a survey of the war children throughout one country after another.

It is impossible to associate either Doctor Carlson or Dr. Alice Hamilton with inhumanity or lack of tender care for helpless creatures; to charge them, or their scientific colleagues, with cruelty is utterly to misapprehend them and their motives.

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CHARLES W. ELIOT, LL.D., President-Emeritus, Harvard University: We owe to scientific experimentation on animals the means of saving hundreds of thousands of children within the past fifty years, and untold millions of children in the coming years. But it is not human beings alone that owe an immense debt to modern animal experimentation. Animals also owe to vivisection great deliverance from disease and death. All the agricultural industries in the United States are deeply indebted to animal experimentation.

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HARRY PRATT JUDSON, until recently president of the University of Chicago: Men of real scientific attainments must not be prevented from pursuing their investigations for the benefit of humanity by idle sentimentality.

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HIS EMINENCE, DENIS CARDINAL DOUGHERTY, Archbishop of Philadelphia, Pa.: To forbid vivisection would be to hamper science, do a mischief to the human race, and foster misplaced sympathy.

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RIGHT REVEREND C. H. BRENT, Bishop of Western New York: I sincerely hope that the efforts made by the antivivisectionists to eliminate this mode of scientific investigation will not meet with success.

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REVEREND JOHN HAYNES HOLMES, Minister of the Community Church, New York: As regards the surgeons who are engaged in this business of vivisection, I have to state that I do not believe for a single moment the charges

that are so wantonly brought against them. I know some of these men. I have met the most distinguished of them, who has been for years under most virulent attack. I have gone through his laboratories, I have witnessed his performance of a vivisection experiment, which was of the character of most severe major operations. To accept the charges of cruelty against scientists of this type—this is a thing impossible to me.

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ERNEST THOMPSON SETON: I learn now from your reply to the Baynes article that you (the opponents of medical science, called antivivisectionists) are opposed to all experiments on living animals, and that you utterly condemn the work of the Pasteur Institute, the Rockefeller Institute and allied laboratories. I have to thank the studies of such institutions for the fact that my wife is alive today. Kindly accept my resignation from the Vivisection Investigation League, to take effect immediately.

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COLONEL DAVID S. WHITE, Chief Veterinarian of the American Expeditionary Forces: Anyone who is familiar with what vivisection has done for mankind and animal kind must realize its value to the world.

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WILLIAM J. MAYO, M. D., The Mayo Clinic, Rochester, Minn.: My brother and I are strongly in favor of vivisection. In the clinic there are large laboratories in which a number of physicians are constantly at work on investigations which depend on animal experimentation.

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PRESIDENT ANGELL of Yale University: We find no obstacle to the practice of animal experimentation in any intuitive moral convictions, nor in the traditional morality of our race.

ANTIVIVISECTION*

By CHESTER ROWELL, LL.D.
Berkeley

I

THE usual antivivisection bill has been introduced in the legislature, this time under the sponsorship (presumably "by request") of Senator Roy Fellom of San Francisco. It would, the dispatches say, "forbid universities, research laboratories and experimental stations from using animals for experiments or demonstrations of any kind."

This is the regular biennial attack, ostensibly on "cruelty," but actually on science. It has never passed the legislature and would be vetoed if it did. Even the periodic efforts to pass it by initiative have met with decisive defeat. Nevertheless, because the opponents of science are persistent, its defenders must be vigilant.

That the real opposition is to science rather than to "cruelty" is shown by the fact that these bills always authorize the infliction of pain on animals for other purposes, but prohibit scientific experiments even without pain. They all permit branding, dehorning, spaying and gelding on farms, without anesthetic, but forbid opening the vein of a mouse or a guinea pig in the laboratory, even under anesthesia. Most of them would prohibit feeding one rat on wheat and another on corn, to study the comparative processes of digestion. They permit the slaughtering of cattle for food and the poisoning of squirrels for protection, but they would forbid a pin-prick in a rabbit to measuse the dose of insulin to save a human life.

The "cruelty" part of the crusade is simply untrue. If the torture tales of current antivivisection pamphlets were correct, then every university president in the United States, every dean of every medical school and every doctor you personally know would be a liar. These are the men to whom we have entrusted the guidance of our youth and the safeguarding of our lives. If they were men who would solemnly lie to the world, on a matter of which they have personal knowledge and cannot be honestly mistaken, that would be worse than the "tortures" of which they are accused. Better close our colleges than have our sons and daughters corrupted by such men, and better die untreated than permit ourselves to be operated on by a surgeon who would lie about an operation on a dog. Instead, these are the very men whom we trust above all others.

The antiscience attack is the more insidious because fewer people are equipped to check its statements. The allegation is that animal experiments have added nothing to human knowledge, anyway. But careful reading will usually disclose that the real meaning is that there is no such knowledge to add to. It is impossible to deny that animal experiments discovered antitoxin and insulin, but it is possible to question whether these were worth discovering. Nobody who knows the facts, to be sure, does question it; but there are many who do not know the facts. It is possible to think that it is right to make soup of the flesh of slaughtered cattle, but wicked to make adrenalin of their glands. Absurd as it seems, some persons do think just that.

So let us get two things straight:

First, "vivisection" is not torture.

Very few laboratory experiments involve cutting, and these are done under an anesthetic, whenever it would be used in operations on human beings. This writer has had done to himself, with and without an anesthetic, practically every surgical thing that is done to animals in laboratories — the last one five minutes before this paragraph was written. And we have all inflicted on rats, to get rid of them, worse suffering than they ever undergo in laboratories.

Most laboratory experiments are medical, not surgical, and involve no more discomfort to the animals than the same diseases do to men. If one sick rabbit will save a thousand sick babies, is not that worth while?

And, second, the real opposition is to science. In a democracy men have that right. A man need not believe that quinin kills malaria or that vaccination prevents smallpox. He may even think that strychnin is not poison. But he must not, on that belief, administer it to others. Neither should he have the power, because he does not know that antitoxin cures diphtheria, to forbid the pin-pricks in horses and guinea pigs, required for production of antitoxin and the measurement of its dosage.

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